

CLIC cost estimate

Hans-H. Braun, CLIC-GDE meeting, February 8, 2008

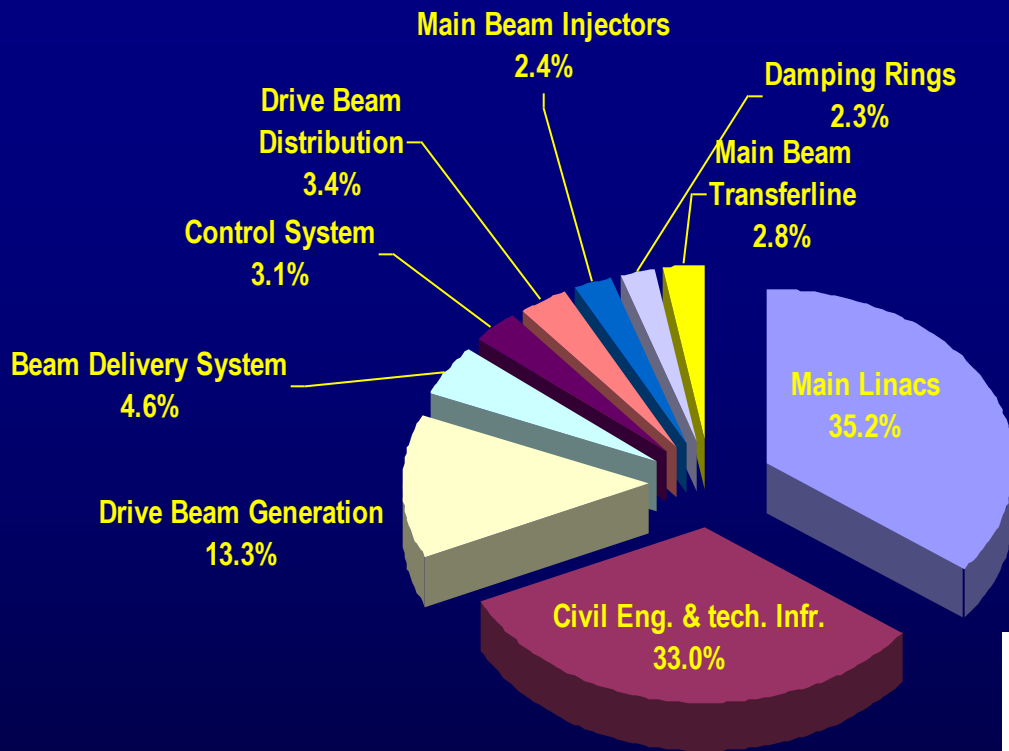
- Cost model goals
- Methodology
- Cost distribution
- Future improvements

Goals of cost study

- Get reasonably precise cost estimate
- Identify cost drivers and assure cost conscious design
- Get cost model scalable in v_{RF} , G and E_{CM} as input for optimization studies

CLIC cost model technical approach

1. For main tunnel equipment (w/o RF structures) steadily improving estimates, but limited accuracy because design is still evolving.
2. For main tunnel RF structures (accelerator and decelerator) estimate based on cost of machining facilities, manpower and material for given production period.
3. Drive beam generator based on CTF3 costs with appropriate scaling except for Klystron + Modulator which are derived from TESLA cost estimate plus some local expert input.
4. Civil engineering and technical infrastructure costs from CERN-TS 2007 study for CE same methods and people as for ILC study
5. Basic assumption for all cost estimates is that CLIC will be constructed at CERN.
6. Key input for injectors, damping rings, BDS, control system from NLC study with some cross checks on recent European projects and gut feeling fudge factors
7. Electricity costs based on present CERN contract
8. Basic tool EXCEL, systematic documentation in EDMS just started



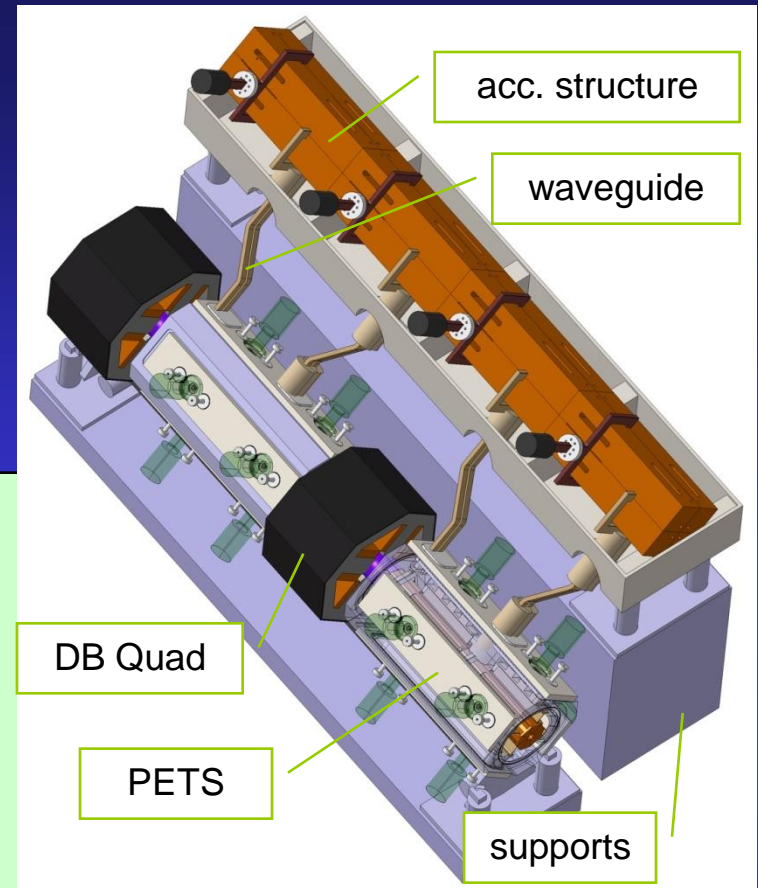
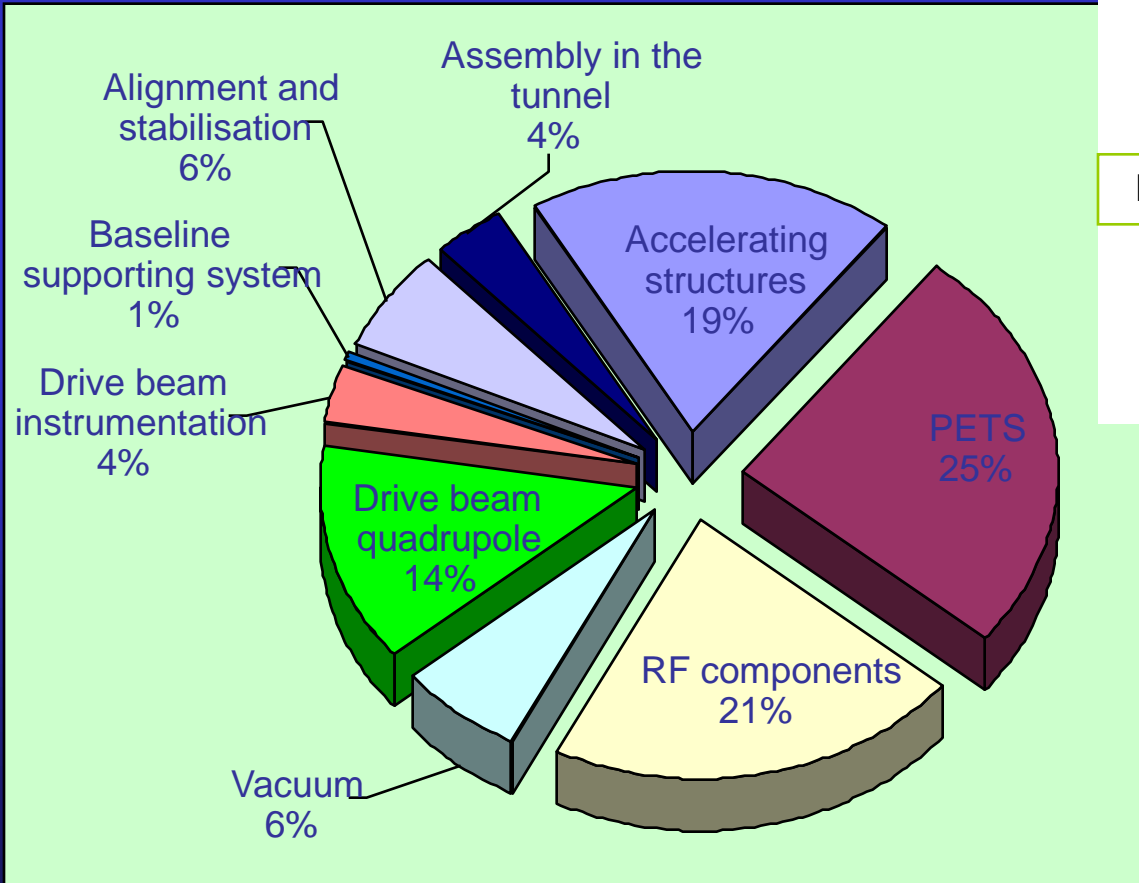
An error in BDS estimate of 50% changes total cost by less than 3%

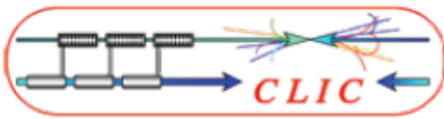
An error in main linac estimate of 50% changes total cost by almost 20%

⇒ Priorities have been to get good cost estimate and reduce costs of

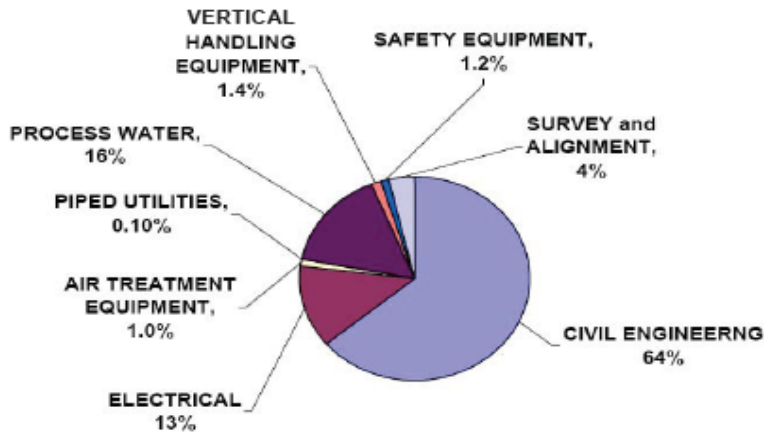
1. **Main linac modules**
2. **Civil engineering**
3. **Drive beam generation**

Standard Linac module cost distribution

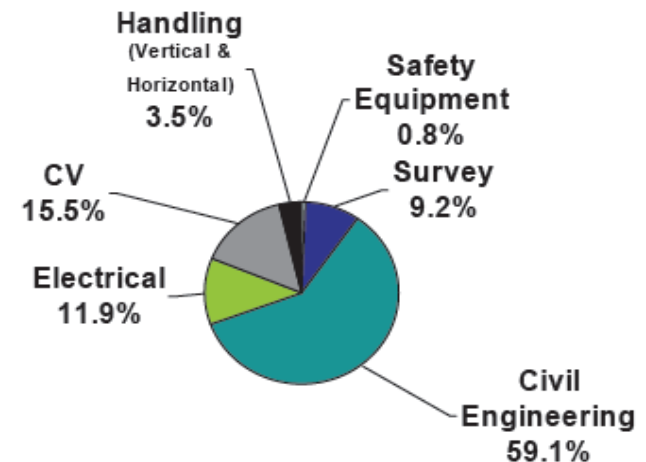




ILC Breakdown (phase 1)



CLIC Breakdown for Lake Cooling Solution (phases 1 and 2)

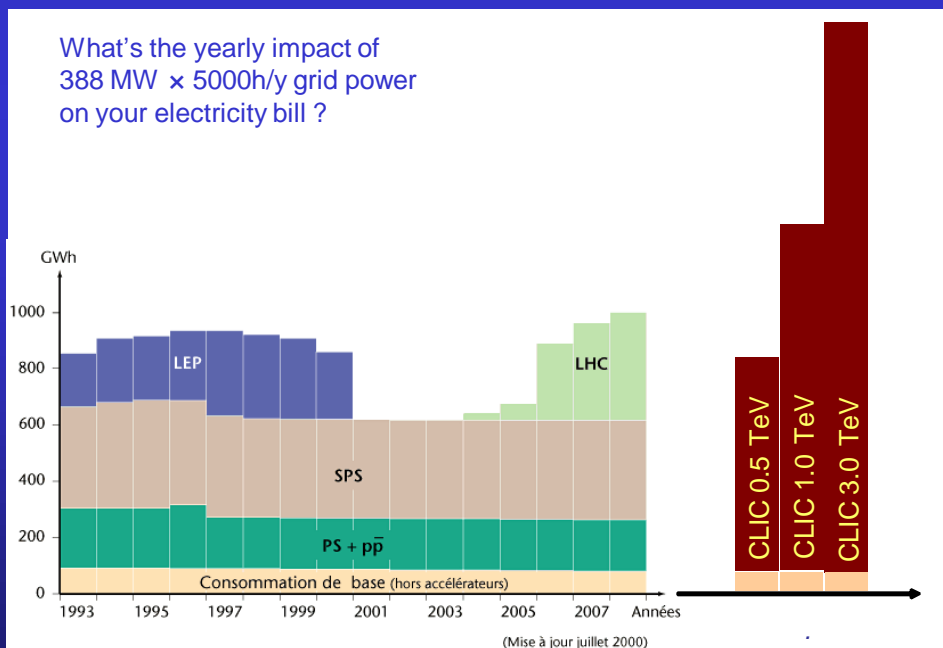


A remark on electricity cost

Present CERN electricity cost is less than one third of ILC assumption

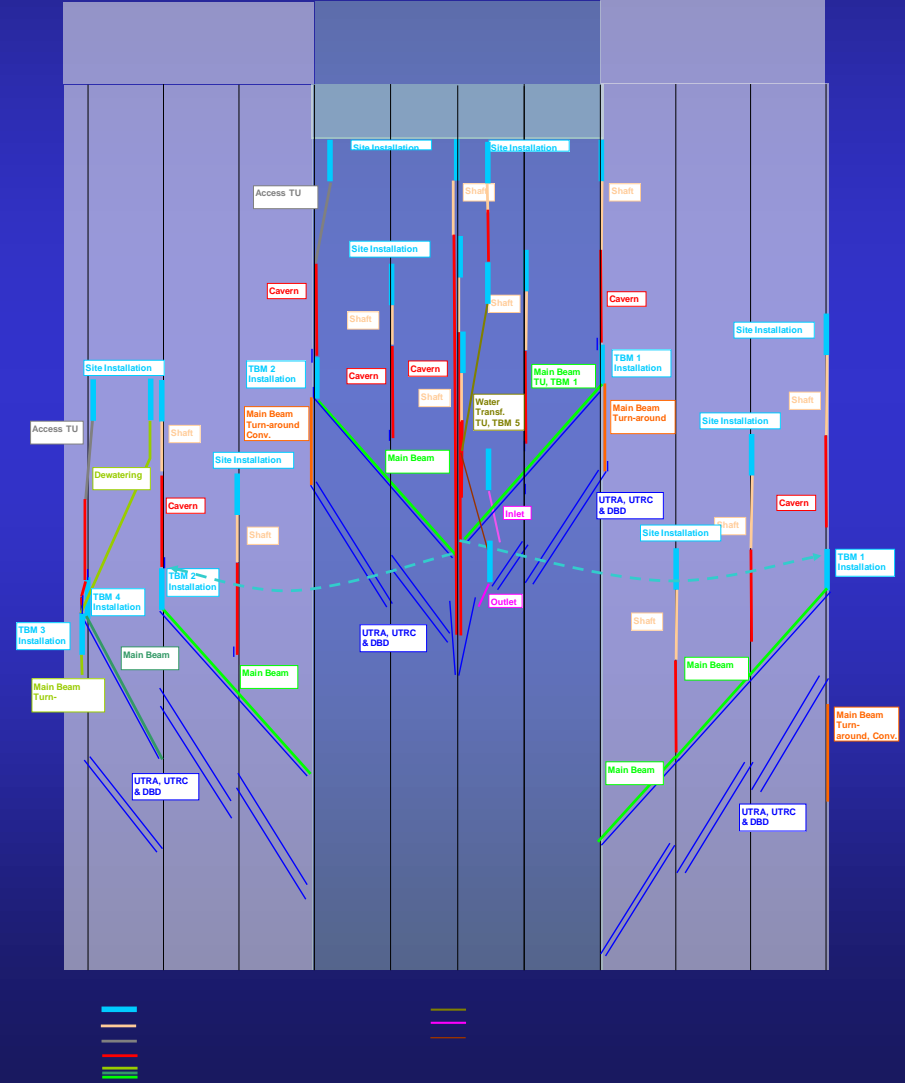
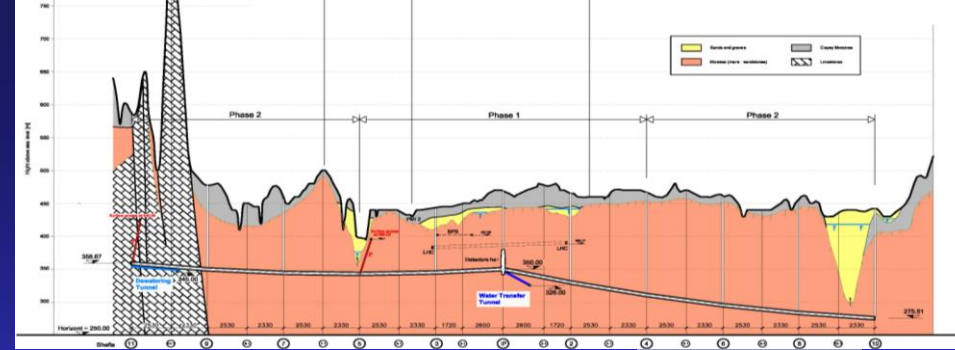
For optimization Alexej uses sum of investment + 10 year electricity cost
Depending on price/kWh electricity cost has a very different weight

ILC electricity cost assumptions per MWh are roughly factor 4 higher

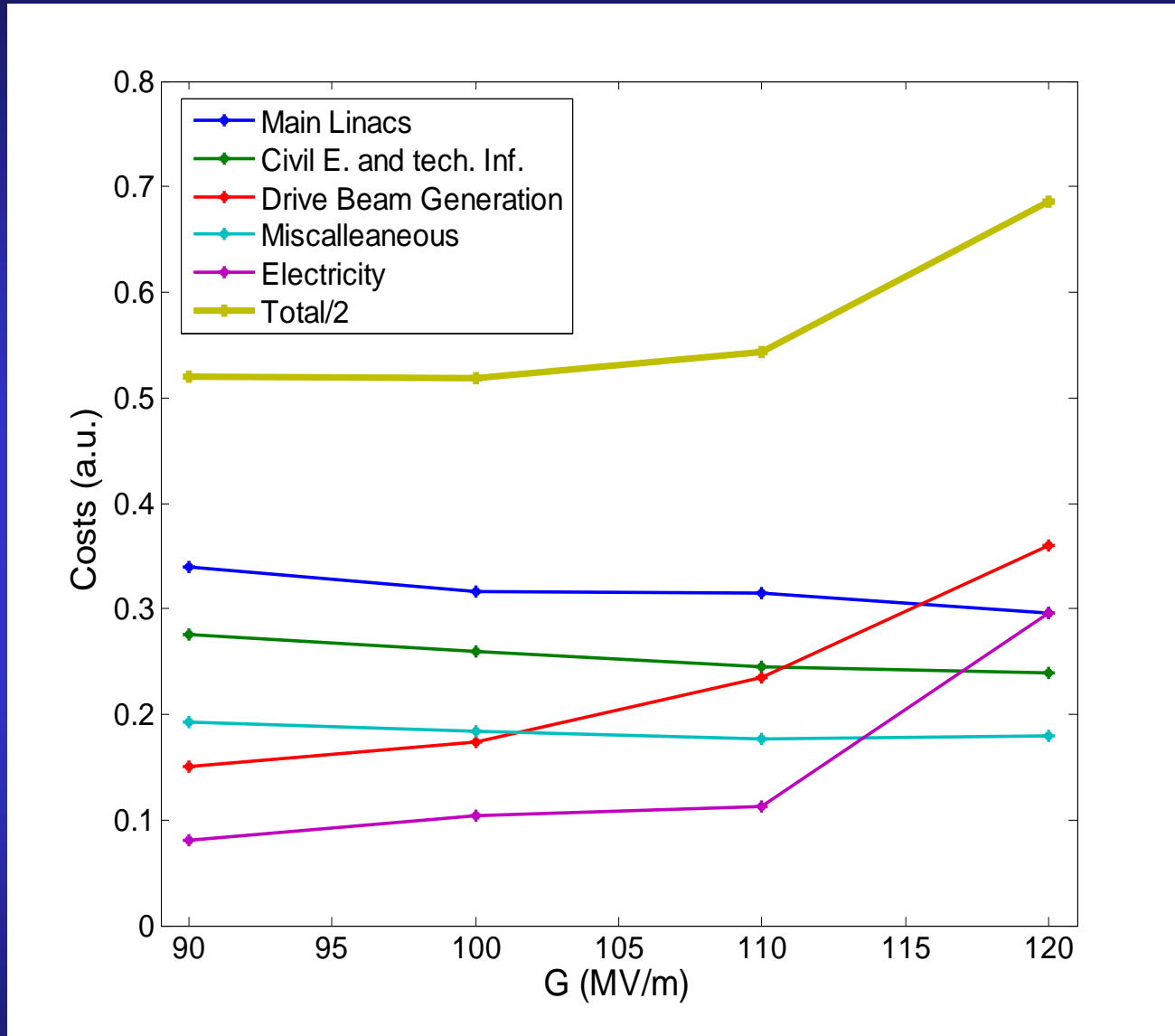


Planning assumed to be
constraint by CE

This sets the time scale for
other components, in particular
for those needing specific
production facilities

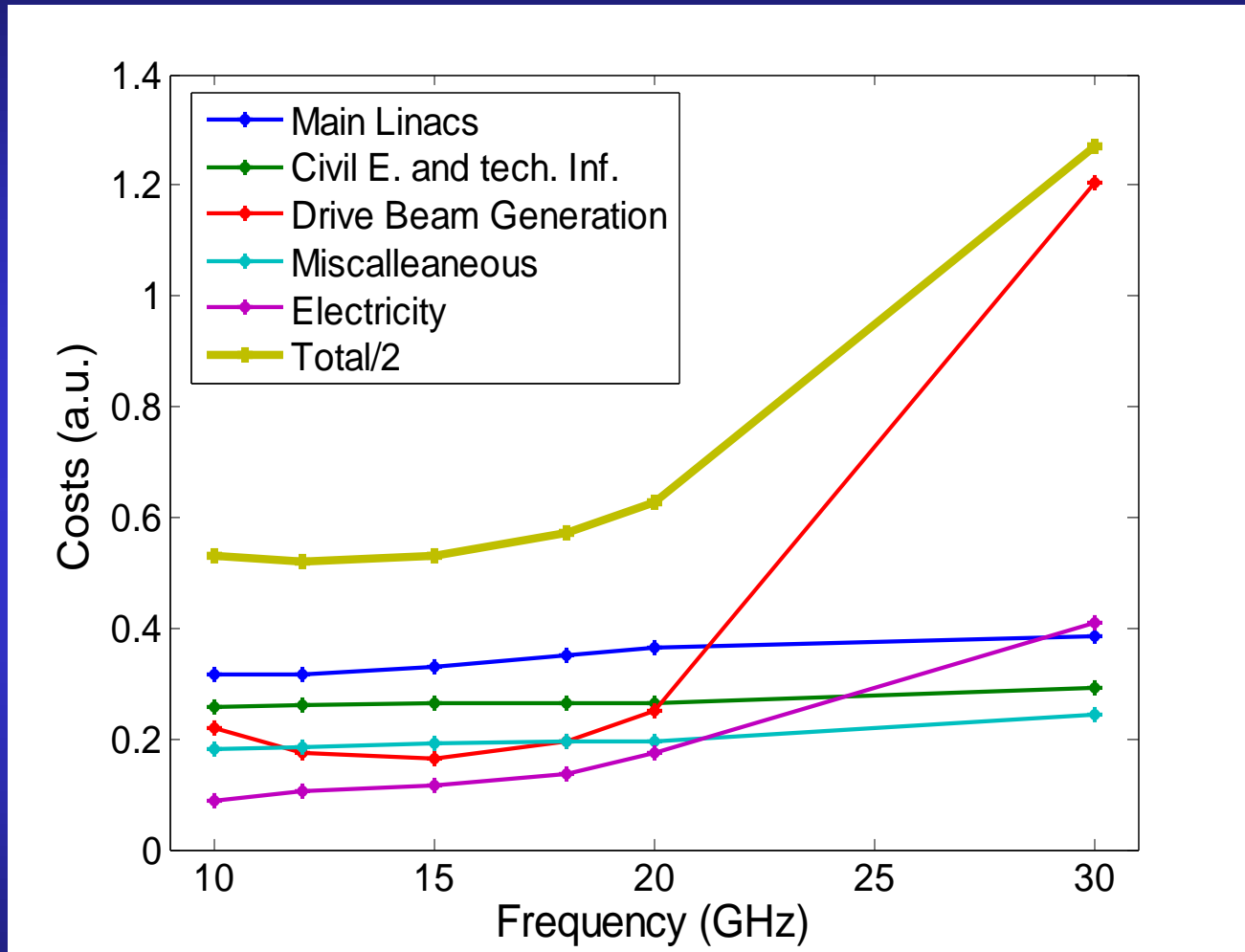


Cost distribution as function of main linac accelerating gradient for $\nu_{RF}=12$ GHz



Based on a set of parameters from Alexej, parameter meeting 14.11.06

Cost distribution as function of main linac frequency for $G=100$ MV/m



Based on a set of parameters from Alexej, parameter meeting 14.11.06

Conclusions and Outlook

- Scalable cost model has been established extrapolating from cost estimate for 2005 nominal parameters.
This model has been extensively used in parameter optimization.
- In 2007 CERN TS department completed cost estimate for civil engineering and technical infrastructures. CE as least as good as ILC estimates but some estimates for technical infrastructure are still crude (in particular electrical distribution).
- Presently a number of CLIC design features is only performance driven and needs revision for potential savings.
- Estimate of subsystems like injectors, DR's and BDS is presently very crude (but impact on totals is small)
- For many components we have only sketchy designs, naturally this limits the precision of the overall estimate
- More systematic approach with complete PBS and planning in preparation
- Consistent approach for risk analysis, functionality to extract cost by component type and character of cost (i.e. manpower, raw material, production facility...) for parametric studies and consistent method for inflation correction wanted.
- For cost of some cost drivers with unprecedented parameters (RF structures, Modulators) studies with industry and/or consultants required and foreseen.